



Mark Scheme (Final)

June 2018

NQF BTEC Level 3 National in
Construction and the Built Environment

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June 2018

Publications Code 20075K_RMS

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General Marking Guidance

- All candidates must receive the same treatment. Examiners must mark the first candidate in exactly the same way as they mark the last.
- Mark schemes should be applied positively. Candidates must be rewarded for what they have shown they can do rather than penalised for omissions.
- Examiners should mark according to the mark scheme not according to their perception of where the grade boundaries may lie.
- All marks on the mark scheme should be used appropriately.
- All marks on the mark scheme are designed to be awarded. Examiners should always award full marks if deserved, i.e. if the answer matches the mark scheme. Examiners should also be prepared to award zero marks if a candidate's response is not worthy of credit according to the mark scheme.
- Where some judgment is required, mark schemes will provide the principles by which marks will be awarded and exemplification may be limited.
- When examiners are in doubt about applying the mark scheme to a candidate's response, the team leader must be consulted.
- Crossed-out work should be marked UNLESS the candidate has replaced it with an alternative response.
- Phonetic spelling should be accepted.

Specific marking guidance for levels-based mark schemes*

Levels-based mark schemes (LBMS) have been designed to assess learners' work holistically. They consist of two parts: indicative content and levels-based descriptors. Indicative content reflects specific content-related points that learners might make. Levels-based descriptors articulate the skills that learners are likely to demonstrate in relation to the assessment outcomes being targeted by the question. Different rows in the levels represent the progression of these skills.

When using a levels-based mark scheme, the 'best fit' approach should be used.

- Examiners should first make a holistic judgement on which band most closely matches learners' response and place it within that band. Learners will be placed in the band that best describes their answer.
- The mark awarded within the band will be decided based on the quality of the answer in response to the assessment focus/objective and will be modified according to how securely all bullet points are displayed at that band.
- Marks will be awarded towards the top or bottom of that band depending on how they have evidenced each of the descriptor bullet points.

Types of marks and abbreviations

This mark scheme uses the following types of marks.

- M marks – method marks are awarded for 'knowing a method and attempting to apply it', unless otherwise indicated.
- A marks – accuracy marks can only be awarded if the relevant method (M) marks have been earned.
- B marks – are unconditional accuracy marks (independent of M marks).
- Marks should not be subdivided.

Abbreviations:

- awrt – answers which round to
- cao – correct answer only
- dp – decimal places
- ft – follow through
- oe – or equivalent (and appropriate)
- SC – special case
- sf – significant figures

BTEC Mark Scheme

Construction and the Built Environment, Unit 1 – 1806

Question Number	Answer	Mark
1a	A – compressive strength	1

Question Number	Answer	Mark
1b	<p>Award one mark for the identification and one additional mark for the appropriate expansion</p> <ul style="list-style-type: none">• Fast to install (1) as it is supplied in large sheets (1).• Suitable for use with a range of types of flooring finishes (1) allowing the same material to be used in all rooms (1).• Environmentally friendly/sustainable material (1) as it is made from recycled wood (1).• Stable material (1) with a consistent finish/no knots (1).• Provides a floor that does not creak (1) as panels are glued to joists (1).• Comes in moisture resistant grades (1) so can be used in all rooms including bathrooms (1).• When supplied with a protective plastic film (1) can be installed before the building is watertight (1).• Lower costs of installation (1) as material is cheaper compared to solid woods/floorboards (1).• Commonly used flooring material(1) therefore stocked by most builders merchants(1) <p>Accept any other valid response.</p>	2

Question number	Working	Answer	Notes	Mark
1(c)	<p>Method 1:</p> <p><u>Area of overall rectangular site:</u> $60 + 80 = 140\text{m}$ $160 + 50 = 210\text{m}$ $210 \times 140 = 29400 \text{ m}^2$ (M1)</p> <p><u>Area of rectangular cut out:</u> $90 \times 60 = 5400 \text{ m}^2$ (M1)</p> <p><u>Area of triangular cut out:</u> $0.5 \times 80 \times 50 = 2000 \text{ m}^2$ (M1)</p> <p><u>Area of site:</u> $29400 - 5400 - 2000 = 22000 \text{ m}^2$ (A1)</p> <p>Method 2:</p> <p>Area of rectangle 1= 160×80 or $12,800$ (M1) Area of triangle = $\frac{1}{2} \times 50 \times 80$ or $2,000$ (M1) Area of rectangle 2=60×120 or $7,200$ (M1) Total area = $12,800 + 2,000 + 7,200 = 22,000$ (A1) m^2</p> <p>Method 3:</p> <p>Area of trapezium = $\frac{1}{2} (160 + 210) \times 80$ (M1) = $14,800$ (A1) Area of rectangle = $60 \times 120 = 7,200$ (M1) Total area = $14,800 + 7,200 = 22,000$ (A1) m^2</p>	<p><u>Area = 22000 (m²)</u></p> <p>Allow follow through for rounding variations and incorrect prior working</p>	<p>M1 for area of the whole site M1 for area of rectangular cut out M1 for area of triangular cut out A1 for total area (ft) Do not penalise if no units are shown</p>	(4)

Question number	Working	Answer	Notes	Mark
1(d)	Length of BC $BC = \sqrt{50^2 + 80^2}$ or $\sqrt{2500 + 6400}$ $BC = \sqrt{8900}$ $BC = 94.3398\dots(m)$ <u>$BC = 94.3 (m)$</u>	<u>$BC = 94.3 (m)$</u>	M1 for correct substitution of Pythagoras A1 for length of BC A1 for answer given to 1d.p. Note: could also be solved using trigonometry	(3)

Question Number	Answer	Mark
2a	Award one mark for any of the following: <ul style="list-style-type: none"> • Brittle mode failure (1). • Compression failure (1). • Shear failure (1). • Tension failure (1). • Bending/torsion failure (1). • Changing loading conditions (1). • Faulty design (1). • Environmental factors/soil alkali/natural disasters (1). • Freezing and thawing / spalling (1). • Structural factors/Load exceeding design (1). • Chemically contaminated water (1). • Using the wrong type of cement (1). • Corrosion of steel reinforcement (1). • Erosion (1) • Cracking (1) • Buckling (1) 	1

Question Number	Answer	Mark
2b	<p>Award one mark for the identification and one additional mark for the appropriate expansion, up to a maximum of four marks.</p> <ul style="list-style-type: none"> • They have a high compressive strength (1) allowing the bridge to be supported safely/will not deviate under pressure/loading/forces (1). • They have low water absorption/relatively waterproof (1) therefore will not be affected by the river (1). • They are resistant to frost attack (1) reducing the chances of damage in the winter (1). • They have a very hard surface/tough (1) protecting them from impact damage (1). • Engineering bricks have chemical resisting properties (1) reducing likelihood of failure resulting from fuel spillage/water pollution (1). • Most class A Engineering bricks do not have perforations (1) so there are no voids to fill with water (1). • Durable material (1) so will resist wear caused by flowing water (1). <p>Accept any other valid response.</p>	4

Question Number	Answer				Mark																												
2c (i)	<table border="1" data-bbox="392 297 1362 864"> <thead> <tr> <th data-bbox="392 297 639 443">Strength of concrete (N/mm²)</th> <th data-bbox="647 297 963 443">Number of samples/frequency</th> <th data-bbox="971 297 1155 443">Midpoint x</th> <th data-bbox="1163 297 1362 443">fx</th> </tr> </thead> <tbody> <tr> <td data-bbox="392 445 639 512">28 ≤ S ≤ 29</td> <td data-bbox="647 445 963 512">2</td> <td data-bbox="971 445 1155 512">28.5</td> <td data-bbox="1163 445 1362 512">57</td> </tr> <tr> <td data-bbox="392 515 639 582">29 < S ≤ 30</td> <td data-bbox="647 515 963 582">3</td> <td data-bbox="971 515 1155 582">29.5</td> <td data-bbox="1163 515 1362 582">88.5</td> </tr> <tr> <td data-bbox="392 584 639 651">30 < S ≤ 31</td> <td data-bbox="647 584 963 651">8</td> <td data-bbox="971 584 1155 651">30.5</td> <td data-bbox="1163 584 1362 651">244</td> </tr> <tr> <td data-bbox="392 654 639 721">31 < S ≤ 32</td> <td data-bbox="647 654 963 721">5</td> <td data-bbox="971 654 1155 721">31.5</td> <td data-bbox="1163 654 1362 721">157.5</td> </tr> <tr> <td data-bbox="392 723 639 790">32 < S ≤ 33</td> <td data-bbox="647 723 963 790">2</td> <td data-bbox="971 723 1155 790">32.5</td> <td data-bbox="1163 723 1362 790">65</td> </tr> <tr> <td data-bbox="392 792 639 860"></td> <td data-bbox="647 792 963 860">Total = 20</td> <td data-bbox="971 792 1155 860"></td> <td data-bbox="1163 792 1362 860">Total = 612</td> </tr> </tbody> </table> <p data-bbox="336 927 651 960">mean = 612/20 = 30.6</p> <p data-bbox="336 994 1326 1173">M1 all five correct midpoints. M1 for correct four of the five fx values or 612 shown or fx is determined consistently from either the lower or higher class width. M1 for correct substitution to calculate the mean strength (612/20). A1 for correct answer for mean (ft) (30.6)</p>				Strength of concrete (N/mm ²)	Number of samples/frequency	Midpoint x	fx	28 ≤ S ≤ 29	2	28.5	57	29 < S ≤ 30	3	29.5	88.5	30 < S ≤ 31	8	30.5	244	31 < S ≤ 32	5	31.5	157.5	32 < S ≤ 33	2	32.5	65		Total = 20		Total = 612	4
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32 < S ≤ 33	2	32.5	65																														
	Total = 20		Total = 612																														
(ii)	<p data-bbox="336 1236 735 1270">median = 30 + 5/8 = 30.625</p> <p data-bbox="336 1303 555 1370">M1 for 30 + 5/8 A1 for 30.625</p>				2																												
(iii)	<p data-bbox="336 1438 635 1471">mode = 30 < S ≤ 31</p> <p data-bbox="336 1505 603 1538">B1 for 30 < S ≤ 31</p>				1																												

Question Number	Answer	Mark
3a	<p>Award one mark for a property of smart glass and one further mark for a description of the its use, to a maximum of four marks.</p> <ul style="list-style-type: none">• Transparency/opacity can be controlled (1) to provide privacy within office spaces/reduces need for blinds (1).• Reduces the amount of UV light entering the offices (1) providing health benefits to employees (1).• Limits the amount of sunlight entering the room (1) which reduces the degradation of décor within the room (1).• Reduces the solar gain inside the offices (1) minimising the need for air conditioning (1).• Minimises glare (1) allowing a more comfortable working environment (1)• Increased energy savings (1) owing to the absorption of light/ retention of heat (1). <p>Accept any other valid response.</p>	4

Question Number	Answer	Mark
3b	<p>Award one mark for the identification and one additional mark for the appropriate expansion to a maximum of four marks.</p> <ul style="list-style-type: none"> • Glare can cause physical discomfort to staff/customers (1) which would make the units unattractive to retailers (1). • Glare could result in the need to install blinds (1) meaning additional lighting would be needed (1). • Glare could result in difficulty carrying out tasks (1) as contrast is reduced (1). • External surfaces of the building (1) can create glare in the surrounding environment (1) • Reflectance of building materials (1) may have an impact on material options available to the architect (1) • Glare affects the use of computer screens (1) making them difficult to see/uncomfortable to use. (1) <p>Accept any other valid response.</p>	4

Question number	Indicative content
3c	<p>Answers will be credited according to learners' demonstration of knowledge and understanding of the need for sound insulation and sound reduction, using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive. Answers may cover some or all of the indicative content but should be rewarded for other relevant answers.</p> <p>A discussion of the reasons why sound insulation and sound reduction are needed in mixed-use complexes.</p> <ul style="list-style-type: none"> • reasons for sound insulation and sound reduction: <ul style="list-style-type: none"> ○ prevent low frequency noise from passing through ○ reduce the potential for vibrations ○ prevent unwelcome noise from formal meetings ○ prevent noise from passing from one retail unit to another ○ to prevent office workers being disturbed/distracted by kitchen noises ○ reduce interference from outside noise ○ prevent echoes from passing through the complex ○ to prevent loss of confidentiality • consideration of the sources of sound/noise <ul style="list-style-type: none"> ○ air conditioning/heating systems ○ cooking ○ automated alarms in shops ○ customers/clients ○ telephones ○ outside noise eg traffic/infrastructure ○ noise from residents footfall, TVs etc • types of activities carried out in different units <ul style="list-style-type: none"> ○ quiet office spaces ○ meetings ○ retail outlets with music playing ○ cooking/eating in restaurants ○ frequent opening/closing of doors

Mark scheme (award up to 9 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.

Level	Mark	Descriptor
Level 0	0	No rewardable material.
Level 1	1–3	<ul style="list-style-type: none"> • Demonstrates isolated knowledge and understanding of relevant information; there may be major gaps or omissions. • Provides little evidence of weighing up competing arguments/pros and cons in context; discussion likely to consist of basic description of information.

		<ul style="list-style-type: none"> • Meaning may be conveyed but in a non-specialist way; response lacks clarity and fails to provide an adequate answer to the question. • The learner has demonstrated a basic understanding of the need for sound insulation and sound reduction.
Level 2	4-6	<ul style="list-style-type: none"> • Demonstrates accurate knowledge and understanding of relevant information with a few gaps or omissions. • Discussion is partially developed, but will be imbalanced; evidences the weighing up of competing arguments/pros and cons in context. • Demonstrates the use of logical reasoning, clarity, and appropriate specialist technical language. • The learner has demonstrated a good understanding of the need for sound insulation and sound reduction.
Level 3	7-9	<ul style="list-style-type: none"> • Demonstrates accurate and thorough knowledge and understanding of relevant information; any gaps or omissions are minor. • Displays a well-developed and balanced discussion, demonstrating a thorough grasp of competing arguments/pros and cons in context. • Logical reasoning evidenced throughout response that is clear and uses specialist technical language. • The learner has demonstrated a well-developed understanding of the need for sound insulation and sound reduction.

Question Number	Answer	Mark
4a	<p>Award one mark for the identification and one additional mark for the appropriate expansion</p> <ul style="list-style-type: none"> • Aluminium alloys can be produced in narrow profiles (1) allowing window/door frames to be made thinner (1). • Aluminium alloys have a long life span (1) reducing the need to replace the window/door units (1). • Aluminium alloys can be supplied in many colours (1) to match the corporate identity of the fast food chain (1). • Aluminium alloys are recyclable (1) reducing the environmental impact of the frames (1). • Aluminium alloys are strong and lightweight (1) reducing the work required to handle them on site (1) • Aluminium is resistant to corrosion (1) has relatively low maintenance (1) <p>Accept any valid responses</p>	2

Question Number	Answer	Mark
4b	<p>Award one mark for the benefit and one additional mark for the appropriate expansion</p> <ul style="list-style-type: none"> • To provide a barrier between the environment and the metal (1) to prevent rusting (1). • To improve aesthetics (1) as the steel can match the colour scheme of the restaurant (1). • To minimise maintenance (1) as the coating will allow an easy cleaning surface (1). • Improve fire resistance (1) by the use of intumescent paint (1). <p>Accept any valid responses</p>	4

Question number	Working	Answer	Notes	Mark
4(c)	Cosine law of illumination $E = (I/d^2) \times \cos \theta$ $E = (300/1.2^2) \times \cos 32$ $E = 208.3 \times \cos 32$ $E = 208.3 \times 0.85$ $E = 176.6 \text{ (lux)}$	E = 176.6	M1 for selection of the correct formula M1 for substitution of the correct values into the formula. M1 for calculating $E = 208.3 \times \cos 32$ or $E = 208.3 \times 0.85$ (ft) A1 for correct value of E (ft) Accept in the range 176.6 to 177 inclusive	4

Question Number	Answer	Mark
4d	<p>Award one mark for the identification and one additional mark for the appropriate expansion to a maximum of four marks.</p> <ul style="list-style-type: none"> • The distance between the light source and sign could be reduced (1) as the intensity is inversely proportional to the distance between the light source and sign (1). • Raise the height of the light source (1) as the more direct the light is the brighter the sign will appear (1). • Increase the intensity (strength/power/wattage) of the light source (1) which will increase the light falling on the sign (1). • Provide a light source that offers greater illuminance (1) such as electroluminescent signage (1). • Add additional light sources (1) to provide combined illuminance of the signage (1) <p>Accept any other valid response.</p>	4

Question Number	Answer	Mark
5a	<p>Award one mark for the identification and one additional mark for the appropriate expansion to a maximum of four marks.</p> <ul style="list-style-type: none"> • Mortar needs some flexibility (1) which allow for movement in the building. (1) • Mortars need to be breathable/hydroscopic (1) which will draw any moisture in the masonry back out into the air (1). • Since the location has a moderate climate (1) mortar requires reasonable impermeability/weather resistance (1). • Mortar should be weaker than the bricks (1) so that any failure/cracking occurs through the joints/allows remedial work to take place without removing bricks (1) • Mortar should have good workability (1) to allow ease of laying bricks/appropriate drying out time (1) • Provides adequate adherence to the bricks/blocks (1) so the joint does not 	4

	<p>separate (1)</p> <p>Accept any other valid response.</p>	
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Question Number	Answer	Mark
5b	<p data-bbox="491 297 1182 405">Award one mark for the identification and one additional mark for the appropriate expansion to a maximum of six marks.</p> <ul data-bbox="507 472 1177 1099" style="list-style-type: none"><li data-bbox="507 472 1177 580">• Use of thermally insulating materials (1) to reduce the effects of conduction through the external envelope of the building (1).<li data-bbox="507 584 1177 692">• Specify double/secondary/triple glazing (1) because double/triple glazing has a lower U value (1).<li data-bbox="507 696 1177 763">• Reduce the amount of thermal bridges (1) by providing continuity of insulation (1).<li data-bbox="507 768 1177 875">• Specify draft proofing / air tightness for windows/doors (1) to reduce likelihood of cold air entering the building (1).<li data-bbox="507 880 1177 987">• Automatic/self-closing doors (1) to minimise the time the door is open to the elements/prevent air flow (1).<li data-bbox="507 992 1177 1099">• Use of balanced flue/room sealed heating systems (1) to prevent heat loss through open flues (1) <p data-bbox="491 1144 935 1178">Accept any other valid response.</p>	6

Question number	Indicative content
5(c)	<p>Answers will be credited according to learners' demonstration of knowledge and understanding of the context, using the indicative content and levels descriptors below. The indicative content that follows is not prescriptive.</p> <p>Answers may cover some or all of the indicative content but should be rewarded for other relevant answers.</p> <p>An analysis of the use of the same designs, materials and construction methods, the appropriateness for the locations, or not, supported by relevant points, which may include:</p> <ul style="list-style-type: none"> • Consideration of the climate at the given location, including rainfall, wind speed and temperatures. • The appropriateness of the materials with regards to the type of construction proposed and how they meet legislative requirements. • Consideration of materials to be used: <ul style="list-style-type: none"> ○ Facing bricks are able to withstand the effects of rain, wind and frost. ○ Facing bricks provide a good range of aesthetic choices for the building designer. ○ Facing bricks can support normal loadings of the house. ○ Facing bricks can be used to provide protection to the framework and sheathing from frost/rain. ○ Concrete raft foundation offer good support to the timber frame and facing walls. ○ Concrete raft foundation can be used in most soft ground types including chalk, gravel and sand. ○ Timber wall and floor frames can be prefabricated off site. ○ Use of timber frames allows for houses to be erected faster. ○ Timber frames do not need to dry out unlike traditional brick/block construction. ○ Timber frames allow internal work to continue in poor weather conditions before completion of the external cladding. ○ Timber frame construction offers greater insulation properties than brick walls. ○ Timber frames can be susceptible to insect attack/rot. ○ Particle board sheathing will need to be protected from damp/moisture. ○ Particle board has good thermal resistivity. ○ Particle board will not suffer from insect attack. • Consideration of location and climate: <ul style="list-style-type: none"> ○ The location is relatively dry and warm meaning materials do not need to withstand extremes. ○ The location has a high proportion of days with rain, but the overall rainfall is quite low.

	<ul style="list-style-type: none"> ○ The location has relatively few days of air frost in a year, therefore materials do not need to cope with extremes of temperature. ○ The location is relatively windy, therefore the materials need to be able to withstand wind loadings. Additionally it is difficult and unsafe to erect timber frames in windy conditions. ● Consideration of design/construction methods: <ul style="list-style-type: none"> ○ The design could be appropriate for low rise houses as an alternative to brick/blockwork cavity wall design. ○ Construction methods, such as traditional brick exterior construction, would be familiar to local workforces. ○ Use of sustainable sources of materials reduces the embedded energy of the houses. ○ Particle board and timber are readily available materials. ○ Gives the appearance of a traditional brick built house but uses modern construction methods. ○ Consideration of weather conditions during building work.
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Mark scheme (award up to 12 marks) refer to the guidance on the cover of this document for how to apply levels-based mark schemes*.

Level	Mark	Descriptor
Level 0	0	No rewardable material.
Level 1	1-4	<ul style="list-style-type: none"> ● Technical vocabulary is used but it is not used appropriately to support arguments in relation to the issues of the question. ● Issues are identified but chains of reasoning are not made, leading to a superficial understanding of the relative importance of issues to the scenario. ● No conclusion is presented or it is generic. ● The learner has demonstrated a basic understanding of the construction form in the given location.
Level 2	5-8	<ul style="list-style-type: none"> ● Accurate technical vocabulary is used to support arguments but not all are relevant to the issues of the question. ● There is consideration of relevant issues using logical chains of reasoning but does not reflect on their relative importance to the given scenario. ● An attempt at a conclusion is presented that links arguments to the given scenario but is not justified, in that it does not reflect the careful consideration of all sides of the argument. ● The learner has demonstrated a good understanding of the construction form in the given location.
Level 3	9-12	<ul style="list-style-type: none"> ● Fluent and accurate technical vocabulary is used to support arguments that are relevant to the issues of the question. ● There is a balanced and wide ranging consideration of relevant issues, using coherent and logical chains of reasoning that show a full awareness of their relative importance to the given scenario.

		<ul style="list-style-type: none">• A fully justified conclusion is presented that links arguments to the given scenario, and that reflects the careful consideration of all sides of the argument, leading to a reasoned decision.• The learner has demonstrated a well-developed understanding of the construction form in the given location.
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Ofqual



Llywodraeth Cynulliad Cymru
Welsh Assembly Government



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